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ABSTRACT

If older children automatically label pictorial stimuli, then their performance should be impaired on tasks in which such labeling would increase the error rate. Children were asked to learn pairs of verbal or pictorial stimuli which, when combined, formed a different compound word (BUTTER-FLY). Subsequently, a false recognition test that included the compound was administered. The error data indicated that verbal labeling occurred only among the older children. (Author)

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Paper presented at Psychonomic Society
November, 1974

The Use of Error Data to Study the Development of Verbal Encoding of Pictorial Stimuli

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Both from the common sense point of view, and from that of developmental theory, it seems obvious that the child must be acquiring visual memories before he begins to acquire verbal memories. The visual system functions almost from birth onward, and there is ample evidence that the infant can differentiate among visual stimuli within the first few months. On the other hand, the beginnings of language and of verbal recognition do not begin until about a year later, and it takes a number of succeeding years before the child acquires the appropriate verbal labels for all the many objects he sees around him.

If the visual memory system does develop considerably prior to the verbal system, then it is reasonable to infer that in learning tasks involving visual and verbal materials, younger children would be relatively superior when visual memory was required, while older children would be relatively superior when verbal memory was required.

Surprisingly, experimental data do not support this reasonable assumption. While empirical evidence is not totally consistent here, there are a series of studies which show that <u>older</u> children are relatively superior on tasks requiring visual memory. One explanation offered for this finding is that, when older children look at a picture, they automatically attach a verbal label

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to the picture. This means that the stimulus can be doubly encoded - once into visual memory and once into verbal memory. It is this double encoding which is believed to be responsible for the superior performance of the older children.

The evidence for this assumption of double encoding in older children has come almost entirely from noting their superior performance on a picture PA learning task. An independent test of the assumption would be to demonstrate that under certain experimental conditions, the occurrence of verbal labeling would result in an inferior performance among older children.

The present study was designed for this purpose. If verbal labeling did occur during PA learning of pictures, the subject's performance on a subsequent recognition test would be impaired. To do this, I made use of a peculiar aspect of the English language, known to crossword-puzzle and word-game fans as the REBUS. A rebus is perhaps best defined by an example: (see Figure 1) two words with distinct concrete meanings -- PEN and KNEE -- when combined, form a new word with a totally different concrete meaning -- PENNY. In the rebus game, a series of pictures are presented, and the challenge is to decipher the pictures into a verbal message. For your entertainment, I have provided a home-made rebus in Figure 1.

The existence of rebuses in the language provides an excellent opportunity to find out about implicit verbal labeling. If a child is presented with a paired-associate learning task in which the stimulus item is a picture of, say, a PEN, and the response item

is a picture of a KNEE, and, if he is also labeling these items, then we would expect that he stores into memory not only the S and R item actually presented (i.e., PEN and KNEE) but also an item not presented (i.e., PENNY). Then, if this third item is included on a subsequent recognition test, it would be expected that subjects who labeled would make more false recognition errors to rebus items than to control items. On the other hand, if no verbal labeling had occurred during the initial picture presentation, then there would be no reason to expect recognition errors to be made to the rebus items.

From this line of reasoning, the following predictions were made: when the PA learning task consists of pictures, older children will make more false recognition errors to rebus items than will younger children. On the other hand, when the PA learning task consists of words -- i.e., when it supplies the verbal labels which represent the pictures -- there will be no difference between older and younger children in number of rebus errors.

Method

Two experiments, highly similar in procedure, were carried out, with Ns of 144 and 192, respectively. Due to time considerations, I will only discuss the first experiment in detail, although the results for both are given in Tables 1, 2 and 3. Also, although all Ss were tested both for recognition and for PA recall, only the recognition data will be discussed today, although the data for associative learning are presented in Table 3. A more extensive discussion of both experiments is "in press" in the Journal of Experimental Child Psychology.

There were four conditions, based on the mode of presentation during learning, and the mode of presentation during the recognition test. (See Table 2.) These were the Word-Word condition (W-W), the Word-Picture (W-P), the Picture-Word (P-W), and the Picture-Picture (P-P). In each condition, the same 16 S-R pairs were presented (either as Words or as Pictures) for 1-trial learning. Subjects were instructed to try to learn the pairs by imagining ways in which the S and R could be combined.

Following a one-minute filler task, the recognition test was given. This consisted of a single sheet of paper on which the 16 S items, the 16 R items, the corresponding 16 Rebuses, and 16 unrelated control items were presented in a random order. Ss were instructed to circle any of the items on this sheet which they had seen on the original learning trial.

An equal number of boys and girls in Grades 2, 4, and 6 were tested.

Results

The number of items in each of the four categories (S, R, Rebus, Control) which were circled on the recognition test was determined for each subject. These data, converted to the proportion of responses made as a function of opportunity, are presented in Table 2. An analysis of variance, based on the raw scores, is presented in Table 1.

The significant F values in Table 1 reflect the following findings:

1) Overall, girls made more responses than boys. (Exp. I only.)

2) More S and R items were circled than were Rebus items, which in turn were circled more often than control items. In other words, Ss did learn the S and R items. However, when they made errors, they were more likely to make them to Rebus items than to Controls.

3) The significant effect for Grade is best understood in terms of the Grade x Item type interaction. Children from the three grades did not differ in correct learning of S and R items, nor in the number of responses to Control items. Where they did differ was in the number of responses to Rebus items. As predicted, second graders made significantly fewer responses to Rebus items than did fourth or sixth graders.

4) The significant effect for Condition is best understood in terms of the Condition x Item type interaction. The fewest correct responses were made to S and R items in the W-P condition, and the fewest responses to Rebus items were made in the P-W and P-P conditions. In fact, in the P-P condition, there was no difference between responses to Rebus and to Control items.

5) A subsequent analysis of the Rebus data alone gave very much the same picture, with an important addition: looking at the number of responses made to Rebus items in the four different conditions, (see Table 2), we see that in the P-W condition, second graders made significantly fewer responses than did fourth or sixth graders, who did not differ from each other. There were no grade-related differences in the other three conditions.

A second experiment (N = 192) replicated these results.

Discussion

In terms of the main hypotheses of this study, the significant Grade x Item type interaction for the recognition test is most important. While children across grades did not differ in correct recognition of S and R items, nor in errors to control items, there was a clear difference in error responses to Rebus items, due to the fact that second graders made fewer such errors in the P-W condition (learn pictures-test words). These results are consistent with the hypothesis that older, but not younger children automatically label pictorial stimuli, since only if such verbal labeling occurred would Rebus errors be made. This statement must be modified, however, by noting that verbal labeling of pictures produced errors only when the recognition test was verbal (i.e., the P-W condition). When both learning and test involved only the visual mode (P-P), such errors did not occur in appreciable number in any grade. Apparently, in the P-P condition, older children could restrict their memory functioning to the visual mode, and thus no interference was produced by prior verbal labeling. In other words, it appears that older subjects have the option of using one or both memory systems, while only the visual system is used by younger children.

While the present results are consistent with the hypothesis that older children automatically label pictures, they do not support the suggestion by Lynch and Rohwer (1972) that such labeling facilitates item learning. In the present study, there was no difference across grades in correct item learning. Thus,

although labeling seems to have produced more errors among the older children, it does not appear to have differentially affected correct item learning. Similarly, there was little evidence on the associative learning test that labeling facilitated learning.

Finally, it should be noted that the greatest number of responses to Rebus items occurred among the fourth graders. While this result was not expected, it may be that fourth grade is a time when the labeling tendency is particularly strong, and hence more likely to produce errors.

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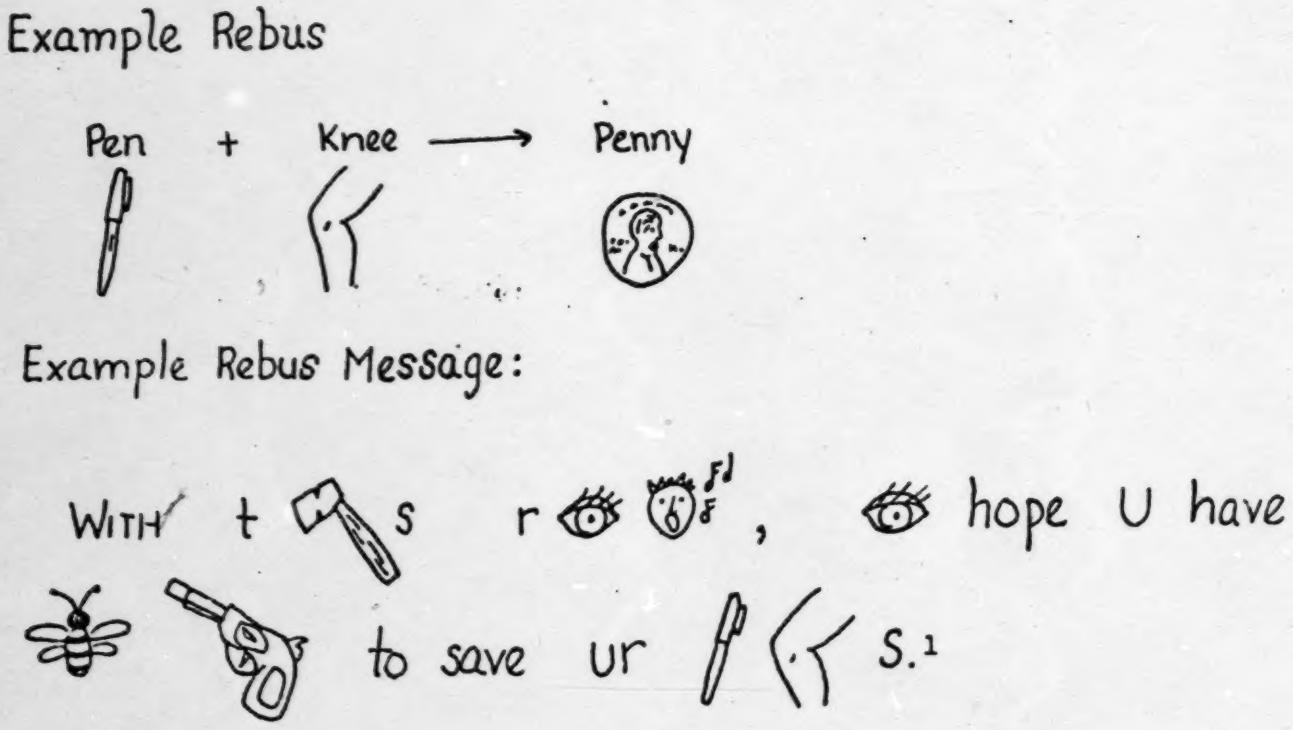
Figure 1



[1]With taxes rising, I hope you have begun to save your pennies.

Table 1

Recognition Test: Analysis of Variance

	EXPERIMENT I				EXPERIMENT II				
	df	MS	F	p		df	MS	F	p
A(Grade)	2	86.63	5.64	.01	A(Grade)	2	19.68	3.41	.01
B(Sex)	1	60.07	3.91	.05	B(Sex)	1	4.84	.83	-
C(Condition)	3	227.06	14.79	.001	C(Condition)	3	162.17	28.10	.001
A x B	2	17.20	1.12	-	A x B	2	2.03	.35	-
A x C	6	19.44	1.27	-	A x C	6	12.31	2.13	-
B x C	3	8.26	.54	-	B x C	3	.98	.16	-
A x B x C	6	7.63	.50	-	A x B x C	6	5.57	.96	-
Error	120	15.35			Error	168	5.77		
D(Item type)	3	4,608.52	391.22	.001	D(Item type)	3	7,080.75	1,353.87	.001
A x D	6	47.75	4.05	.01	A x D	6	20.36	3.89	.01
B x D	3	7.65	.65	-	B x D	3	4.89	.93	-
C x D	9	411.02	34.89	.001	C x D	9	373.59	71.43	.001
A x B x D	6	4.19	.36	-	A x B x D	6	8.99	1.71	-
A x C x D	18	11.73	.99	-	A x C x D	18	9.52	1.82	-
B x C x D	9	2.31	.20	-	B x C x D	9	7.17	1.37	-
A x B x C x D	18	6.76	.51	-	A x B x C x D	18	1.55	.29	-
Error	360	11.78			Error	504	5.23		

Table 2

Recognition Test:

Mean Proportion Responses to Each Item Type, by Grade and Condition[a]

	W-W				W-P				P-W				P-P			
	S	R	Rebus	Control	S	R	Rebus	Control	S	R	Rebus	Control	S	R	Rebus	Control
Second Grade																
Exp. I	.78	.83	.41	.05	.41	.35	.41	.03	.81	.85	.03	.00	.90	.84	.02	.00
Exp. II	.94	.88	.76	.01	.88	.82	.73	.04	.93	.93	.11	.02	.98	1.00	.00	.00
Fourth Grade																
Exp. I	.70	.71	.67	.05	.52	.44	.67	.02	.84	.96	.52	.00	.92	.88	.07	.00
Exp. II	.96	.95	.81	.00	.76	.78	.89	.09	.96	.99	.49	.02	.98	1.00	.03	.00
Sixth Grade																
Exp. I	.84	.88	.46	.01	.42	.36	.63	.02	.90	.91	.23	.00	.92	.91	.10	.00
Exp. II	.94	.94	.63	.00	.80	.88	.72	.07	.96	.97	.34	.01	.99	1.00	.10	.01

[a]There were 16 items of each type in Exp. I, 14 in Exp. II.

Table 3

Associative Learning:

Mean Proportion Correct Responses[a]

	W-W[b]	W-P	P-W	P-P
Second Grade				
Exp. I	.81	.74	.74	.60
Exp. II	.84	.71	.45	.51
Fourth Grade				
Exp. I	.87	.82	.84	.78
Exp. II	.91	.84	.75	.65
Sixth Grade				
Exp. I	.90	.79	.81	.77
Exp. II	.99	.87	.83	.82

[a] There were 16 R items in Exp. I, 14 in Exp. II.

[b] The first letter refers to the learning modality, The second to the test modality. Thus, W-W = learn words-test words.